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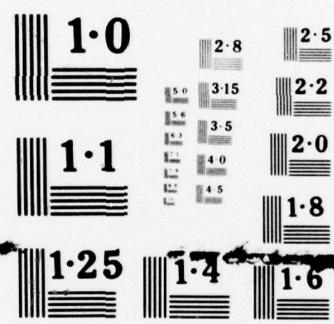
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FOREIGN TECHNOLOGY DIVISION

BRAKE-PLATES FOR AEROPLANES

by

Lee, Dong Sheng

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EDITED TRANSLATION

FTD-ID(RS)T-0819-77 31 May 1977

MICROFICHE NR: FTD-77-C-000648

CSL76086926

BRAKE-PLATES FOR AEROPLANES

By: Lee, Dong Sheng

English pages: 4

Source: Hang Kung Chih Shih, Peking, 1976,
Number 4, pp. 8

Country of origin: China
Translated by: Linguistics
F33657-76-D-0389
Jerry K. Chung
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Brake-plates for Aeroplanes

Lee, Dong Sheng

As a result of the increase in both the weight and air speed of modern aeroplanes, increase in their speed and kinetic energy during landing inevitably ensues. At present, a jet airliner travelling at a speed of 250~350 kilometers per hour on landing will slide over a distance of more than 3500 meters before stopping if it has no braking facility, thereby necessitating an airport of very large size. The application of brakes will help bring it to rest in about 1000 meters, which means a significant reduction of 2/3~3/4 of the original length, thus allowing the use of an airport of smaller size. It also enables the aeroplane to make turns on the ground by means of the adjustment in braking moments of the left and right wheels, thus providing the aircraft with great mobility on the ground. It is evident then that the braking system of an aeroplane is very important. Aeroplane brakes are often found in one of the three forms : the so-called "bent-plates", "tubular", and "disc" types. Regardless of their forms, however, the most important factor that determines the efficiency of brakes is the quality of the brake-plates. For a modern jet airliner, its brake-plates are usually subject to a temperature of 450~500°C due to surface friction when brakes are applied during landing. It can even reach 1000°C upon excessive use of the brakes. When the kinetic energy of heat equivalent of 1800 Kcal. of a modern jet-propelled bomber is delivered onto its brakes, 350 calories of heat are given off per square centimeter area of the brake surfaces in 15~20 seconds, which is sufficient to melt a gram of iron. For aircrafts with larger tonnage and higher landing speed, the quantity of frictional

heat generated is even more enormous. The outer layers of the brakes not only become softened, but will even melt . We see then that the working conditions of an aeroplane braking system are very exacting, and high-quality brake-plates must be used. Brake-plates made from asbestos-plastics material in the past do not meet the needs of the modern high performance aeroplanes. They are replaced by brake-plates made by means of powder metallurgy and other methods that guarantee excellent heat-resistance, durability, operational stability and reliability. Here we shall introduce a type of brake-plates made by means of powder metallurgy.

According to the desired properties of brake-plates, iron or copper are commonly used as the main constituent, with lesser amounts of tin, lead, graphite, and carborundum. These elements and compounds vary considerably in their melting points and other physical and chemical properties. For example, the melting point of tin is 232°C, whereas those of graphite and carborundum are well above 2000°C. Consequently, it is rather difficult to obtain material with the desired properties by means of ordinary melting and casting techniques. The introduction of powder metallurgy alleviates these problems; it is simple to apply, and is economical in the use of raw materials. The principal processing steps include : mixing, compacting, and sintering. Different kinds of prepared powders are first mixed in a mixing machine, whereupon the mixture is placed in a die and pressed into shape by the compacting machine. Since the die is designed with the exact dimensions and shape of the brake-plate, the compact will come out to have the dimensions and shape required. The compact is then sintered in a special sintering

furnace. The sintering temperature for brake-plates made of iron is generally in the range of 900~1000 °C, whereas for the case of copper, it is about 750~850 °C. The structure of the sintered product resembles that of mortar. The metal components, i.e., iron or copper, plays similar role as does cement in mortar : it glues firmly together the uniformly distributed non-metal components such as graphite and carborundum with its high cohesive strength, so that the resulting structure is extremely strong. After some simple working, the sintered brake-plates are either riveted onto the steel framework of the braking system, or sintered directly onto the latter. Figure 1 shows a brake-plate of the "disc" type braking system made by powder metallurgy for an aeroplane, whilst Figure 2 is a diagram of an assembled brake disc.

Recently, a few new kinds materials for brakes appear in the market. For example, there is a type of brake disc made of carbon-carburized compounds which has small specific gravity and excellent ability in heat absorption and resistance against abrasion. It has been developed into practical use already. In fact, the Concord aircrafts built by the joint efforts of Britain and France utilize this kind of material. There is another type of brake disc made of beryllium which has small specific gravity and large specific heat, and whose ability in heat absorption per unit weight is 4~5 times than that of copper. It is believed to be an ideal material for brakes, and is actually used for a certain kind of military transportation aircrafts. Each aircraft with 24 wheels weighs 726 kilograms less than that if copper is used. Another kind of material made of metal fibres and ceramic substances is also under investigation. Although the aforementioned materials exhibit many advantages, they

are not yet extensively used at present because of technical and economic reasons. However, judging from the current trend, we believe they have a very promising future.

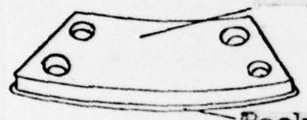

Figure 1. Brake-plate Made by Powder Metallurgy

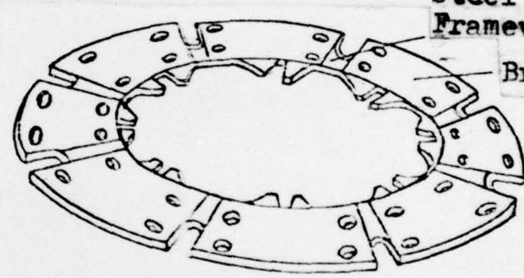

Figure 2. Brake Disc with Brake-plates Assembled on

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER FTD-ID(RS)T-0819-77	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) BRAKE-PLATES FOR AEROPLANES		5. TYPE OF REPORT & PERIOD COVERED Translation
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Lee, Dong Sheng		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Foreign Technology Division Air Force Systems Command United States Air Force		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS		12. REPORT DATE 1976
		13. NUMBER OF PAGES 4
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number)		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) 01; 13		

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